VALIDATION OF STRESS INDICATORS FOR THE ASSESSMENT OF ANIMAL WELFARE AND THE PREDICTION OF PORK QUALITY VARIATION

Luiene Moura Rocha
MEAT QUALITY

Housing

Genetics

Nutrition

Health

Transport

Stunning

Preslaughter handling
ECONOMIC LOSSES

- Occurrence of the “downer syndrome” (non-ambulatory; up to 30% price discount)\(^1\);

- Skin bruises (\$0.44 value loss per carcass);

- Meat quality defects (PSE and DFD);
  - Excess softness or edema (decrease the value of the pork cut by \$5).  

1- Ritter et al., 2009 2-Rindeau et al., 2010, 3- Murray, 2001
The majority of meat quality defects are directly related to physiological status of pigs.

- Heart rate;
- Respiratory rate;
- Blood lactate;
- Body temperature;
- Etc..
Validate tools that could be useful as stress indicators at farm and slaughter plant and would help to assess animal welfare and predict pork quality variation

- Hand-held blood lactate analyser (Study 1);
- Audits from farm to slaughter plant (Study 2);
Study 1 – Hand-held lactate analyzer as a tool for the real-time measurement of blood lactate during slaughter and pork quality prediction
<table>
<thead>
<tr>
<th>Parameters</th>
<th>11.00</th>
<th>32.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood lactate, mM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pH</td>
<td>7.35</td>
<td>7.11</td>
</tr>
</tbody>
</table>

1- Ivers et al., 2002
Enzymatic analytical procedure

Lactate Scout Analyser

\[ r = 0.97 \]

pH 45 min \( (r = -0.32; \quad P < 0.001) \)

Drip loss \( (r = 0.22; \quad P = 0.02) \)

Edwards et al., 2010
**Animals and treatments**

- **Groups**
  - 50 pigs were kept in lairage overnight (G1).
  - 50 pigs were kept in lairage 2–3h before slaughter (G2).

**6 slaughter days**

**Samples of pigs**

- Multiple trucks/day
- 100 pigs/slaughter day
MATERIALS AND METHODS

✓ Blood lactate measurement
Sampling points

- Unloading - UN
- Restrainer - RE
- End of lairage - LA
- Exsanguination – Wound - EX
Meat quality assessment

- pH 45 min.
- 24 h post-mortem

25 carcass from each group (Total of 50/day).

Objective Color - Minolta CR 300

pH 24 h

Drip Loss
RESULTS AND DISCUSSION

- Blood Lactate (mMol)

- Sampling points:
  - Unloading
  - Lairage
  - Restrainer
  - Exsanguination

Rocha et al. 2012. 58th ICoMST, Montreal, Canada
### Results and Discussion

- Correlation between blood Lactate level and Pork Quality in SM and AD muscles

<table>
<thead>
<tr>
<th></th>
<th>UN</th>
<th>LA</th>
<th>RE</th>
<th>EX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N= 291</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SM muscle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pHi</td>
<td>-0.13*</td>
<td>0.07</td>
<td>-0.03</td>
<td>-0.39***</td>
</tr>
<tr>
<td>pHu</td>
<td>0.29*</td>
<td><strong>0.40</strong>*</td>
<td>0.16*</td>
<td>0.10</td>
</tr>
<tr>
<td>L*</td>
<td>-0.21***</td>
<td>-0.18***</td>
<td>-0.07</td>
<td>0.12*</td>
</tr>
<tr>
<td>Drip loss</td>
<td>-0.24***</td>
<td>-0.27***</td>
<td>-0.09</td>
<td>0.08</td>
</tr>
<tr>
<td><strong>AD muscle</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pHu</td>
<td><strong>0.28</strong>*</td>
<td><strong>0.40</strong>*</td>
<td><strong>0.31</strong>*</td>
<td><strong>0.20</strong>*</td>
</tr>
</tbody>
</table>

UN = Unloading, LA = End Lairage, RE = restrainer, EX1: exsanguination (ear), EX2: exsanguination (bleeding wound); *P<0.05, ***P<0.001.

Rocha et al. 2012. 58th ICoMST, Montreal, Canada
When blood lactate using the LSA is taken just after lairage and at exsanguination, the observed blood lactate variation may explain the pH variation in pork meat as measured in the ham muscles.

Therefore, the measurement of blood lactate by the handheld scout analyzer can be useful to pork processors to monitor the welfare of pigs in lairage and implement modifications in the handling systems aiming at improving pork quality and control meat quality losses.
Study 2 – Does the monitoring of animal welfare parameters through the supply chain (from farm to slaughter) predict pork meat quality variation?
Getting animals from farm to abattoir forms the first link in the chain of meat production\(^1\);

Quiet, calm handling of slaughter pigs can reduce the incidence of carcasses with pale, soft and exudative muscle by 10% to 12% \(^2\);

To have quiet handling, it is essential to bring easy to handle pigs to the plant \(^3\).

- Genetics;
- On farm-handling conditions.

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1– Warriss, 1992  
2– Grandin, 1998d  
3– Grandin, 1993
✓ American Meat Institute;
✓ Animal care Assessment – Canadian Pork Council;
✓ Welfare Quality® protocol;
MATERIALS AND METHODS

12 Farms – Audits WQ® 1 Week before slaughter

Loading audits: **Handler skills and animal behaviour**
(2 x/ Week)

Audits on arrival: Transport conditions and waiting time before unloading

Slaughter audits: Unloading, stunning efficiency and thermal comfort

Blood lactate: Bleed rail (60 pigs/farm)

Meat Quality: LD muscle - **24 h post-mortem** (60 pigs/farm)
MATERIALS AND METHODS

Good feeding:
1. Absence of prolonged hunger;
2. Absence of prolonged thirst;
3. Good housing;
4. Thermal comfort;
5. Ease of movement;

Good Health:
6. Absence of injuries;
7. Absence of disease;
8. Absence of pain induced by management procedures;

Appropriate behaviour:
9. Expression of social behaviours;
10. Expression of other behaviours;
11. Good human-animal relationship;
12. Positive emotional state.
Correlation between WQ® scores and pork quality in the LD muscle

<table>
<thead>
<tr>
<th>Good Feeding</th>
<th>Good Housing</th>
<th>Health Condition</th>
<th>Approp. Beh.</th>
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</thead>
<tbody>
<tr>
<td>L*</td>
<td>0.06</td>
<td>0.46</td>
<td>-0.39</td>
</tr>
<tr>
<td>Drip loss</td>
<td>0.06</td>
<td>0.39</td>
<td>-0.65*</td>
</tr>
<tr>
<td>pHu</td>
<td>-0.35</td>
<td>-0.94 **</td>
<td>0.72**</td>
</tr>
</tbody>
</table>

**P < 0.001  *P < 0.05  NS = P > 0.10

Rocha et al. 2013. CSAS/CMSA Mtg Banff, AB
✓ Meat quality variation in the LD muscle between farms

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pHu</strong></td>
<td>5.61&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.68&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>5.62&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.72&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.65&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.70&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>Drip Loss</strong></td>
<td>4.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.21&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>4.94&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>3.04&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.20&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>L</strong></td>
<td>50.36&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.35&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>50.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>48.70&lt;sup&gt;b&lt;/sup&gt;</td>
<td>50.16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>49.79&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.03</td>
</tr>
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Rocha et al. 2013. CSAS/CMSA Mtg, Banff, AB
✓ Preliminary results demonstrate that the implementation of on-farm animal welfare auditing may help control the variation of important pork meat quality traits.
The use of these new technologies may encourage innovation for a better integration of animal welfare in the meat production chain;

Ensuring better animal welfare increases profits and expands market opportunities due to the availability of certified products, resulting in economic benefits for the whole pork chain.

“You cannot manage what you cannot measure”
THANK YOU VERY MUCH!

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